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Noteworthy records of bats (Mammalia, Chiroptera) from southeastern Peru

Farah Carrasco-Rueda[1*], Diego J. Zavala[2], Yolanda Alcarraz[3], Luiggi Carrasco-Escudero[4,5], Hugo T. Zamora[2]

1 Keller Science Action Center, The Field Museum of Natural History, Chicago, IL, USA • farahcarrasco@gmail.com https://orcid.org/0000-0003-1686-2249

2 Museo de Historia Natural Universidad Nacional de San Agustín, Arequipa, Peru • DJZ: zav3.diego@gmail.com https://orcid.org/0000-0002-9796-6287 • HTZ: tommyzm@gmail.com https://orcid.org/0000-0003-3824-3449

3 Centro de Ornitología y Biodiversidad, Lima, Peru • vulpemustela@gmail.com https://orcid.org/0000-0001-5739-9583

4 Programa de Conservación de Murciélagos del Perú, Piura, Peru • carrasco.luiggialessandro@gmail.com https://orcid.org/0000-0002-6621-7451

5 Facultad de Ciencias, Universidad Nacional de Piura, Castilla, Piura, Peru

* Corresponding author

Abstract

Based on recent bat surveys in the Department of Madre de Dios, Peru, we present distribution records for *Thyroptera wynneae* Velazco et al., 2014 and *Molossops temminckii* (Burmeister, 1854), which extend the known distributions and represent the southernmost records of these species in Peru. We also present records of *Molossus alvarezi* González-Ruiz et al., 2011, which are the easternmost occurrences for this species in the country. Also included are new records of *Eumops maurus* (Thomas, 1901) and *Molossus coibensis* Allen, 1904 which fill existing gaps in the knowledge of the distribution of these species in the Neotropics.

Keywords

Disk-winged bat, free-tailed bat, Madre de Dios, Molossidae, *Thyroptera*

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Introduction

Information on the natural history and distribution of species in the Neotropics is essential to understanding the diversity of the region. In countries like Peru, more information is needed for several species to better understand their conservation status and establish measures to guarantee their protection and long-term survival. In the case of bats, there are an estimated 187 species for the country (Velazco 2020), a number that continues to rise with increased field studies and revisionary work in museum collections.

The thyropterid *Thyroptera wynneae* Velazco, Gregorin, Voss & Simmons, 2014 has been reported from the Department of Loreto, in northeastern Peru, as well as in the southeastern Brazilian states of Minas Gerais (Velazco et al. 2014) and Espírito Santo (Hoppe et al. 2014). *Thyroptera wynneae* is considered by the

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International Union for Conservation of Nature (IUCN) to be Data Deficient, highlighting the need for more information about this species' natural history and geographic distribution.

Eumops maurus (Thomas, 1901) is a molossid, originally described as *Molossus maurus*, from the savannahs in the Kanaku Mountains, Guyana. It was later assigned to the genus *Eumops* (Miller, 1906). This species has been recorded in Venezuela (Sánchez H. et al. 1992), Guyana, Surinam (Husson 1962), Ecuador (Reid et al. 2000), Brazil (Sodré et al. 2008; López-Baucells et al. 2018), and Peru (Luna et al. 2002; Díaz 2011). The southernmost record for *E. maurus* is in the state of São Paulo, Brazil. Species of *Eumops* are insectivores with high, fast flight (Sodré et al. 2008). The IUCN classifies this species as Data Deficient.

Molossops temminckii (Burmeister, 1854) is a monotypic molossid species, originally described as *Dysopes temminckii* from Lagoa Santa, Minas Gerais, Brazil (Eger 2008). This species is widely distributed in South America and present in all countries except Chile, Guyana, and Suriname (Marín-Vasquez and Aguilar-González 2005; Guillén-Servent and Ibáñez 2007; Eger 2008; Tirira 2017). In Peru, *M. temminckii* was reported in the Department of Pasco (Tuttle 1970); in the department of Ucayali, in the basin of the La Novia River, a tributary of the Purus River (Ruelas et al. 2018); and in the Department of Loreto, it was reported in the basin of the Samiria (Ruelas et al. 2018) and Curaray rivers (Koopman 1978) and from the Allpahuayo-Mishana National Reserve (Hice et al. 2004). The IUCN categorizes this species as Least Concern.

The genus *Molossus* É. Geoffroy Saint-Hilaire, 1805 is currently represented by 14 species widely distributed in the Neotropics (Loureiro et al. 2020). In Peru, four species are recognized: *Molossus alvarezi*, *Molossus coibensis*, *Molossus molossus*, and *Molossus rufus* (Velazco 2020). These species are found in the Pacific rainforest, equatorial dry forest, coastal desert, steppe mountains, yungas, lowland Amazon forest, and savanna, as well as in urban areas (Pacheco et al. 2009; Wilson and Mittermeier 2019; Loureiro et al. 2020).

Molossus alvarezi González-Ruiz, Ramírez-Pullido & Arroyo-Cabrales, 2011 was described based on 46 specimens from the Yucatan Peninsula of Mexico. Loureiro et al. (2019) further extended its distribution to Central and South America. *Molossus alvarezi* can be distinguished from other species of the genus by its size and the color of its pelage, among other morphological characteristics. In Peru, *M. alvarezi* was previously reported as *M. sinaloae* at Hacienda Luisiana, Ayacucho (Eger 2008) and Isla de Patmos, Palcazú, Oxapampa, Pasco (Pérez 2017). The southernmost record of this species is at Ayacucho (Eger 2008). This species is classified by the IUCN as Data Deficient.

Molossus coibensis Allen, 1904 is a monotypic species distributed from Mexico, through Central America, to the southeast of Brazil (Eger 2008; Wilson and Mittermeier 2019). In Peru, Medina et al. (2016) reported this species in savannas from the Pampas del Heath, which is the southernmost record in Peru. It also has been recorded 19 miles [~30.6 km] south from Tingo María in Huánuco (Dolan 1989), in a downtown building in Iquitos, Loreto (Díaz 2011), and at Jenaro Herrera (Loureiro et al. 2018a), also in Loreto. The IUCN classifies this species as Least Concern.

Here we report new localities for *Thyroptera wynneae*, *Molossops temminckii*, *Molossus alvarezi*, *Eumops maurus*, and *Molossus coibensis* in the Department of Madre de Dios, Peru. These new data add to the knowledge of the distribution of these species in Peru and in the Neotropics.

Methods

We sampled bats in several locations along the Interoceanic Highway, Department of Madre de Dios, Peru, as part of an ecological study (Carrasco-Rueda and Loiselle 2020). To capture bats, we set up ground-level mist nets (12 × 3 m) at five different points located every 75 m along 300 m long transects. Transects were in agricultural land with papaya plantations or cattle pastures, the forest interior, and at the forest edge. We placed 10 mist nets in L-shaped pairs in the forest interior and in agricultural land, but along the forest edge, we placed 15 mist nets in five sets of three nets in a "T" shape. For further details on sampling design, refer to Carrasco-Rueda and Loiselle (2020) and Carrasco-Rueda (2018).

Each transect was sampled one night during each visit from 17:30 h to 23:30 h. We did not sample during rainy nights or during two days before, the day of, and two days after a full moon to avoid possible effects on bat captures (Saldana-Vazquez and Munguia-Rosas 2013). We checked mist nets for bats every 30 min. Once released from mist nets, we placed the bats in individual cloth bags and took them to a temporary camp.

This study was undertaken with the following permits: University of Florida IACUC Study #201708351 and the Peruvian permit Resolución Directoral Regional No. 948-2016-GOREMAD-GRRNYGA/DRFFS. Occurrence data for the specimens reported in this article can be found in Carrasco-Rueda et al. (2021). For handling bats, we followed the guidelines provided by the American Society of Mammalogists (Sikes et al. 2016). All collected specimens were fixed in 10% formalin and then preserved in 70% ethanol. Voucher specimens were cataloged at the Centro de Ecología y Biodiversidad (CEBIO).

The skulls were removed from the bodies for subsequent cleaning and fixation. All measurements defined below were taken with digital calipers accurate to 0.01 mm. To allow comparisons, we followed different authors in the way measurements were done for *Thyroptera wynneae* and the species of the family Molossidae. For the identification of *Thyroptera wynneae*, we followed measurements presented by Velazco et al. (2014): forearm length (FA); greatest length of skull (GLS);

condyloincisive length (CIL); braincase breadth (BB); rostral length (ROL); zygomatic breadth (ZB); postorbital breadth (PB); maxillary toothrow length (MTRL); width at M3 (M3–M3); length of mandible (LMA); and mandibular toothrow length (MANDL). To identify the species of Molossidae, we followed measurements presented by Freeman (1981): forearm length (FA); greatest length of skull, not including incisors (GSL); condyloincisive length (CIL); condylobasal length (CBL); braincase breadth (BB); rostral length (ROL); zygomatic breadth (ZB); postorbital breadth (PB); palatal length (PL); maxillary toothrow length (MTRL); width at M3 (M3-M3); length of mandible (LMA); mandibular toothrow length (MANDL); and breadth across upper canines (C–C). In the case of *Molossus alvarezi*, we followed González et al. (2011) to measure the greatest length of the skull (GLS) from the union of the sagittal and lambdoidal crests to the anterior surface of the incisors.

Results

Thyroptera wynneae Velazco, Gregorin, Voss & Simmons, 2014

New records. PERU • 1 ♀; Department of Madre de Dios, Province of Tambopata, District of Las Piedras, in the limits of Alegría town; 12°05′22″S, 069°6′45″W; 250 m a.s.l.; 28 Oct. 2016; F. Carrasco-Rueda leg.; mist nets; well-maintained forest adjacent to a cattle pasture area inside a private property; CEBIOMAS 0516 (Fig. 1).

Identification. External and cranial measurements in millimeters were taken along (Fig. 2) with data from holotypes and paratypes (Table 1; Velazco et al. 2014).

Thyroptera wynneae differs from *T. devivoi*, *T. lavali*, and *T. tricolor* by its shorter forearm (≤34.4 mm) and smaller greatest length of skull (≤13.5 mm) but overlaps in size from *T. discifera*. *Thyroptera wynneae* can be distinguished from all the other species in the genus by its tricolored ventral pelage with a light brown overall appearance. *Thyroptera wynneae* and *T. tricolor* have two lappets that project posterolaterally from the shaft of the calcar, contrasting with the little developed lappet that may even be absent of *T. devivoi*, and the single lappet present in both *T. discifera* and *T. lavali*. A unique characteristic of *T. wynneae* is the rostrum considerably shorter than the braincase and the height of the lower incisors, which are subequal compared to differently sized lower incisors in the remaining thyropterids (Hoppe et al. 2014; Velazco et al. 2014). Our female specimen fits with the external character's description for this species but differs by the greatest length of the skull (GLS = 14.2 mm) which is longer than the holotypes and paratypes (Table 1, Fig. 2).

Remarks. The capture event occurred between 17:30 h and 18:00 h. It is remarkable that the greatest length of the skull for the Madre de Dios specimen is larger than the holotypes and paratypes (Fig. 3). Nevertheless, this would be expected for species with few specimens. This is the first female specimen collected for the species. Other species captured in the same location are *Artibeus glaucus*, *Artibeus lituratus*, *Artibeus obscurus*, *Artibeus planirostris*, *Carollia brevicauda*, *Carollia perspicillata*, *Chiroderma trinitatum*, *Chiroderma villosum*, *Glossophaga soricina*, *Lophostoma silvicolum*, *Mesophylla macconnelli*, *Phyllostomus elongatus*, *Platyrrhinus incarum*, *Sturnira giannae*, *Sturnira tildae*, *Trinycteris nicefori*, *Uroderma bilobatum*, *Uroderma magnirostrum*, *Eptesi-*

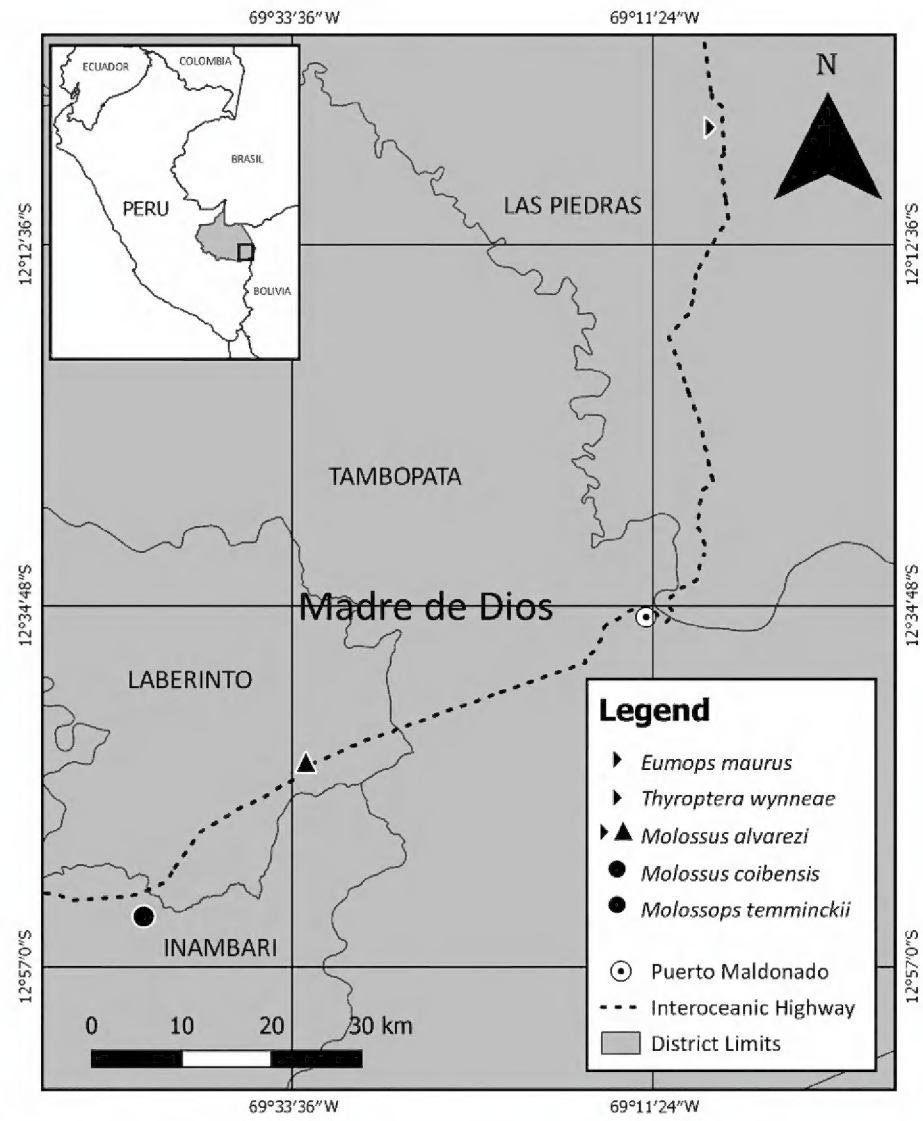

Figure 1. Location of new records for *Eumops maurus*, *Thyroptera wynneae*, *Molossus alvarezi*, *Molossus coibensis*, and *Molossops temminckii* from the Department of Madre de Dios, Peru.

Table 1. Measurements (mm) of *Thyroptera wynneae* specimen collected compared to the ranges reported by Velazco et al. (2014).

Code	Velazco et al. 2014			This study CEBIOMAS 0516
	Holotype male	Paratype male	Paratype male	female
Total length	68	64.4	65.9	66
LT	26	26.4	26.7	27
HF	4	4.4	3.9	4.4
Ear	11	12.5	12.7	11.5
FTL	4	3.1	3.2	2.3
FA	33	34.2	34	33.2
GLS	13.2	13.8	12.9	14.2
CIL	12.5	13.2	13.6	13.4
BB	6.7	6.5	6.9	6.8
ROL	4.9	5	5	5.1
ZB	6.8	7.2	7.1	7.1
PB	2.6	2.5	2.5	2.6
MTRL	5.3	5.6	5.5	5.7
M3–M3	4.8	5	4.8	4.9
LMA	9.9	10.6	10.2	10.7
MANDL	5.5	6.2	5.7	6.1

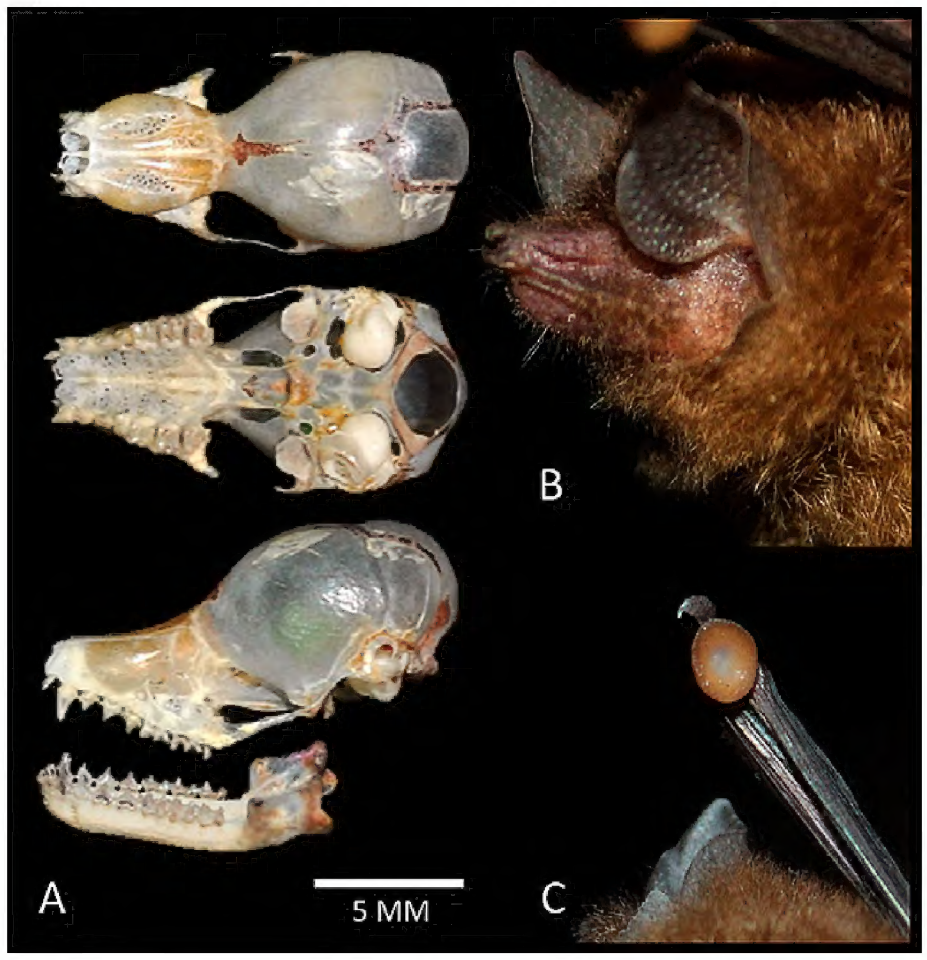

Figure 2. *Thyroptera wynneae* (CEBIOMAS 0516) collected at Alegría, Tambopata, Madre de Dios, Peru. **A.** Skull. **B.** Headshot of live specimen. **C.** Oval disk at base of thumb.

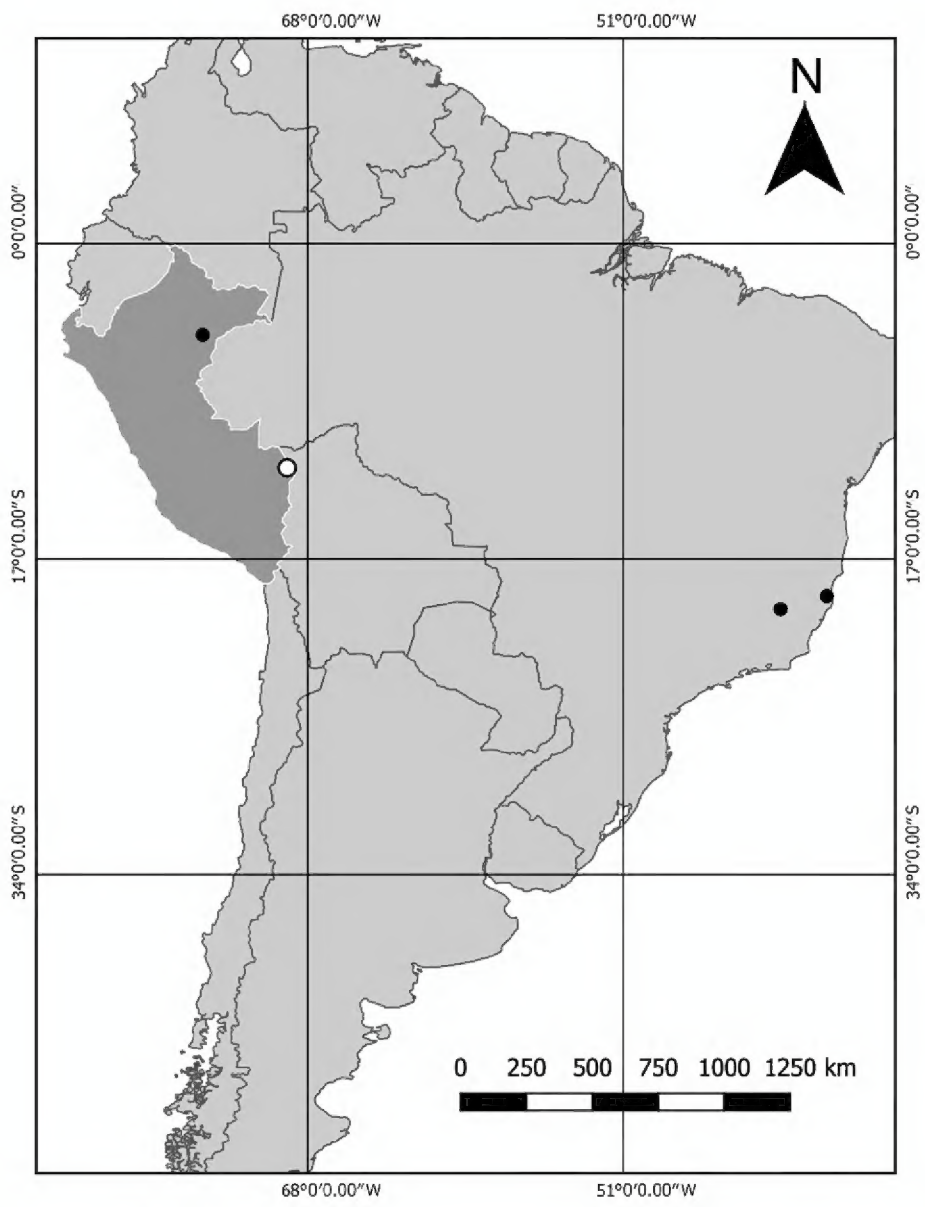

Figure 3. Distribution of *Thyroptera wynneae* in South America, white dot shows this study report, black dots show previous reports that includes holotype and paratype locations for the species.

cus brasiliensis, *Myotis riparius*, *Molossus alvarezi*, and *Eumops maurus*.

Eumops maurus (Thomas, 1901)

New records. PERU • 1 ♀; Department of Madre de Dios, Province of Tambopata, District of Las Piedras, limits of Alegría town; 12°05′22″S, 069°06′45″W; 250 m a.s.l.; 29 Oct. 2016; F. Carrasco-Rueda leg.; mist net; pasture area with the presence of cattle inside a private property; 225 m from the Interoceanic Highway; 200 m away from the forest edge; ~100 m away from a permanent stream; CEBIOMAS 0517.

Identification. Our specimen has the distinctive band of pure white hairs in the proximal ventral plagiopatagium that characterize the species. It presents overall chocolate-brown pelage in the dorsal and ventral regions and an oval, relatively shallow pit in its basisphenoid bone (Best et al. 2001; Sodré et al. 2008; Gregorin 2009; López-Baucells et al. 2018). The forearm of this specimen is 54.3 mm, and the greatest length of skull is 20.3 mm, falling within the range of this species reported in the literature (Best et al. 2001; Sodré et al. 2008; Gregorin 2009; López-Baucells et al. 2018) (Table 2, Fig. 4).

Remarks. The capture event occurred between 23:00 h and 24:00 h. Other species captured in the same location (Fig. 5) are *Artibeus glaucus*, *Artibeus lituratus*, *Artibeus obscurus*, *Artibeus planirostris*, *Carollia brevicauda*, *Carollia perspicillata*, *Chiroderma trinitatum*, *Chiroderma villosum*, *Glossophaga soricina*, *Lophostoma silvicolum*, *Mesophylla macconnelli*, *Phyllostomus elongatus*, *Platyrrhinus incarum*, *Sturnira giannae*, *Sturnira tildae*, *Trinycteris nicefori*, *Uroderma bilobatum*, *Uroderma magnirostrum*, *Eptesicus brasiliensis*, *Myotis riparius*, *Molossus alvarezi* and *Thyroptera wynneae*.

Molossops temminckii (Burmeister, 1854)

New records. PERU • 1 ♂; Department of Madre de Dios, Province of Tambopata, District of Inambari; 12°53′03″ S, 069°42′45″W; 250 m a.s.l.; 2 Nov. 2016; F. Carrasco-Rueda leg.; mist net; well-maintained forest adjacent to a cattle pasture area inside a private property; 1167 m from the Interoceanic Highway; 200 m away from the forest edge; ~700 m away from a permanent stream; CEBIOMAS 0518.

Identification. This specimen shows the determinant characteristics of the species. *Molossops temminckii* is one of the smallest species in the family Molossidae, with a forearm length of 28–33 mm, greatest length of skull 12.7–14.5 mm, palatal length 5.5–6.7 mm, zygomatic breadth 8.6–9.7 mm, breadth of braincase 6.8–7.6 mm (Freeman 1981; Castilla et al. 2010; Ruelas et al. 2018; Gamboa and Diaz 2019). Characteristics of this species include: dark-brown dorsal pelage with pale base, frosty brown ventral region which is paler than the back, tail free for at least half of its length, snout pointed and bare, small pointed warts surrounding nostrils, ears widely separated at the crown and triangular with slightly rounded tips, lips smooth, and upper and lower lips aligned because the upper lip is tilted backwards (Freeman 1981; Eger 2008; Ruelas et al. 2018; Gamboa and Diaz 2019). The male examined presents a forearm similar to the description (FA = 31.3 mm), but some cranial characters are slightly larger

Table 2. Measurements (mm) of the molossid specimens collected.

Code	*Molossus coibensis*	*Molossus coibensis*	*Molossus alvarezi*	*Molossus alvarezi*	*Eumops maurus*	*Molossops temminckii*
	CEBIOMAS 0519 male	CEBIOMAS 0521 male	CEBIOMAS 0515 female	CEBIOMAS 0513 female	CEBIOMAS 0517 female	CEBIOMAS 0518 male
FA	36	35.7	49	49.3	54.3	31.3
GLS	15.99	16.06	20.65	20.85	20.30	14.87
GLSI	16.78	17.24	20.23	20.65	21.51	15.65
CIL	15.78	15.91	18.73	19.48	20.24	14.45
CBL	15.20	15.26	18.17	18.86	19.22	14.04
BB	9.36	9.25	9.68	9.91	9.84	7.97
ROL	6.42	6.37	7.58	7.63	8.72	6.16
ZB	11.23	11.27	11.91	12.45	12.8	9.93
PB	4.1	3.96	3.72	3.92	4.4	4.34
PL	5.95	5.93	6.95	7.37	8.98	7.2
MTRL	6.1	5.99	7.13	7.45	8.22	5.78
M3–M3	4.76	4.79	5.16	5.31	5.71	3.98
LMA	11.74	11.89	13.66	14.48	15.74	10.85
MANDL	6.97	6.88	8.2	8.41	8.93	6.17
C-C	4.71	4.68	5.27	5.57	5.32	4.18

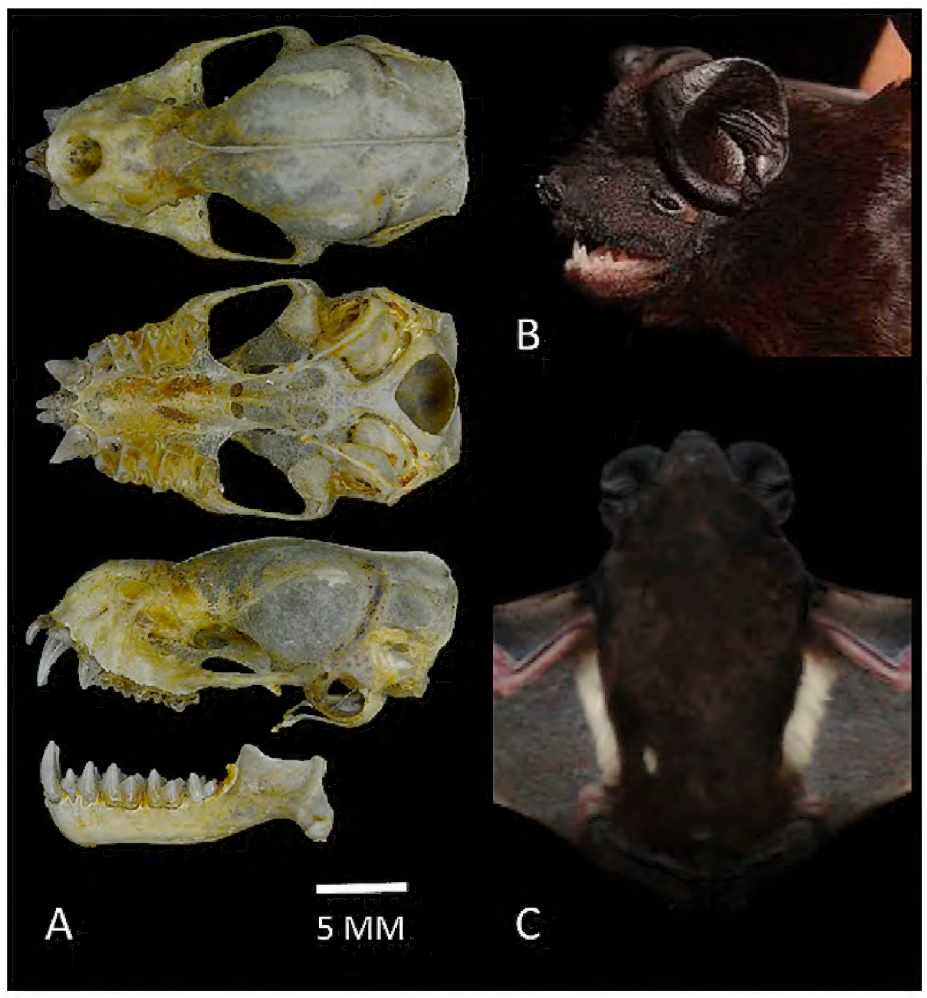

Figure 4. *Eumops maurus* CEBIOMAS 0517 collected at the limits of Alegría town, Tambopata, Madre de Dios, Peru. **A.** Skull. **B.** Head-shot of live specimen. **C.** Ventral view of specimen.

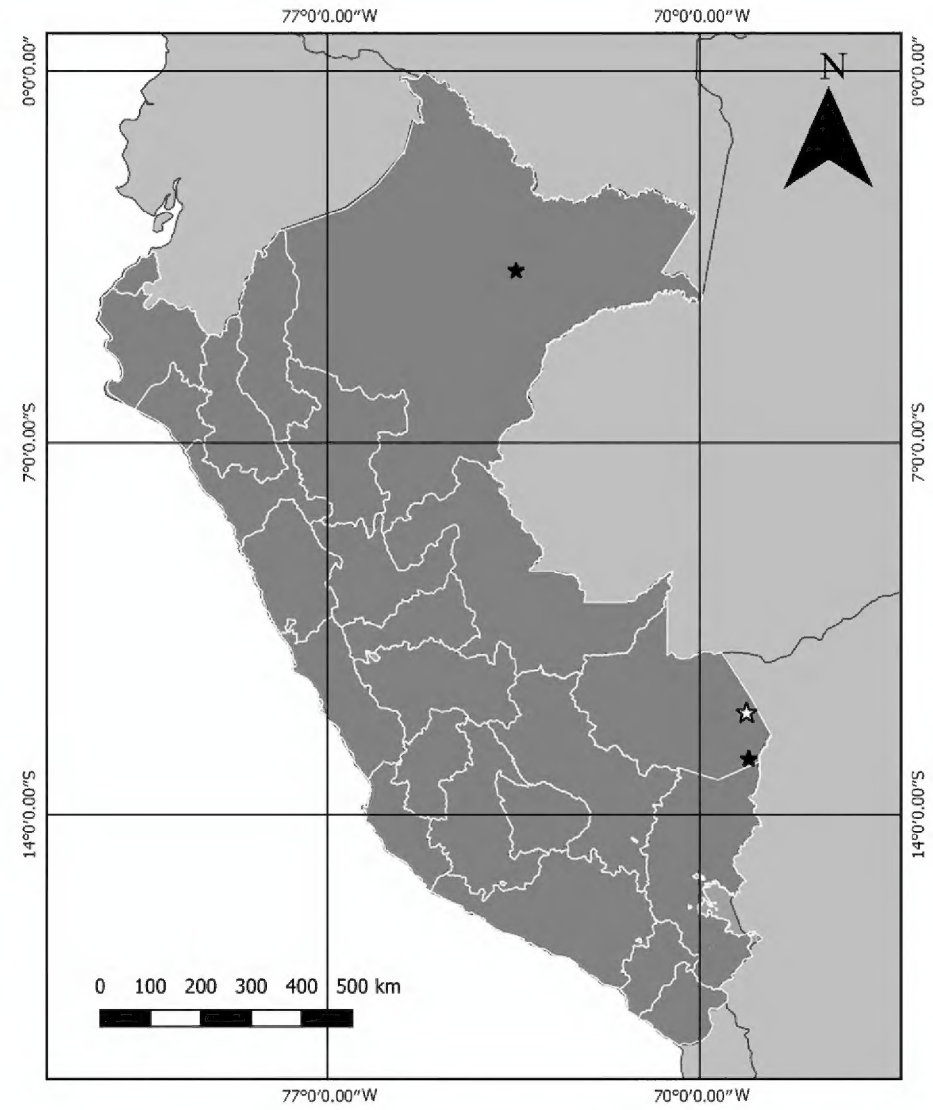

Figure 5. Distribution of *Eumops maurus* in Peru, white star shows this study report, black stars show previous reports.

than those known in the literature (GLS = 14.87; PL = 7.2; ZB = 9.93; BB = 7.97). Our record for *M. temminckii* represents the southernmost occurrence for the species in Peru (Table 2, Figs. 6, 7).

Remarks. The capture event occurred between 18:00 h and 18:30 h. Other species captured in the same location (Fig. 7) are *Artibeus lituratus*, *Artibeus obscurus*, *Artibeus planirostris*, *Carollia brevicauda*, *Carollia perspicillata*, *Glossophaga soricina*, *Lophostoma brasiliense*, *Lophostoma silvicolum*, *Mesophylla macconnelli*, *Phyllostomus elongatus*, *Phyllostomus hastatus*, *Platyrrhinus brachycephalus*, *Platyrrhinus incarum*, *Rhinophylla pumilio*, *Sturnira giannae*, *Sturnira tildae*, *Tonatia maresi*, *Trachops cirrhosus*, *Uroderma bilobatum*, *Uroderma magnirostrum*, *Vampyressa thyone*, *Vampyriscus bidens*, *Eptesicus brasiliensis*, *Molossus coibensis*, *Molossus* sp., and *Eptesicus furinalis*.

Molossus alvarezi González-Ruiz, Ramírez-Pulido & Arroyo-Cabrales, 2011

New records. PERU • 1 ♂; Department of Madre de Dios, Province of Tambopata, District of Las Piedras in the limits of Alegría town; 12°05′23″S, 069°06’51″W; 250 m a.s.l.; 3 Aug. 2016; F. Carrasco-Rueda leg.; mist net; forest edge between a well-maintained forest and a cattle pasture area inside a private property; 503 m from the Interoceanic Highway; ~100 m away from a permanent stream; CEBIOMAS 0513 • 1 ♂; same collection data as for preceding; 27 Oct. 2016; CEBIOMAS 0515.

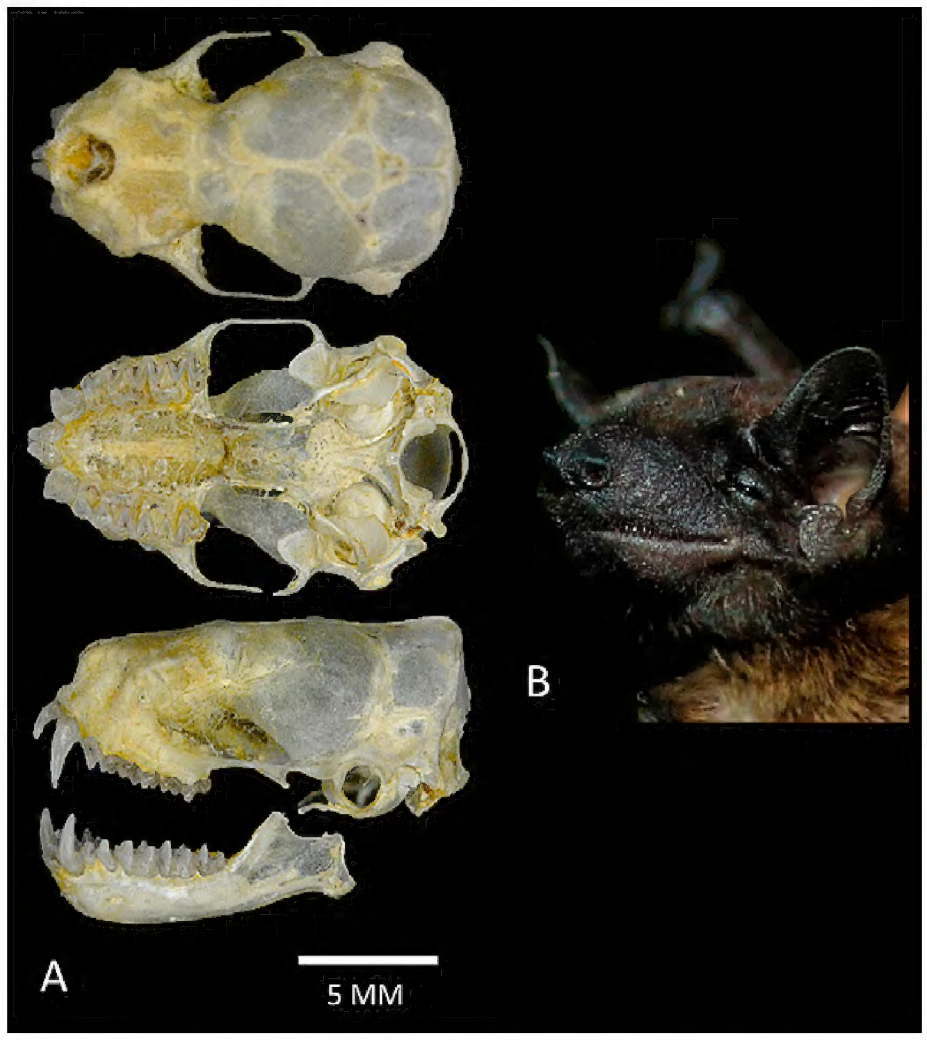

Figure 6. *Molossops temminckii* CEBIOMAS 0518, km 70 Interoceanic Highway, Tambopata, Madre de Dios, Peru. **A.** Skull. **B.** Headshot of live specimen.

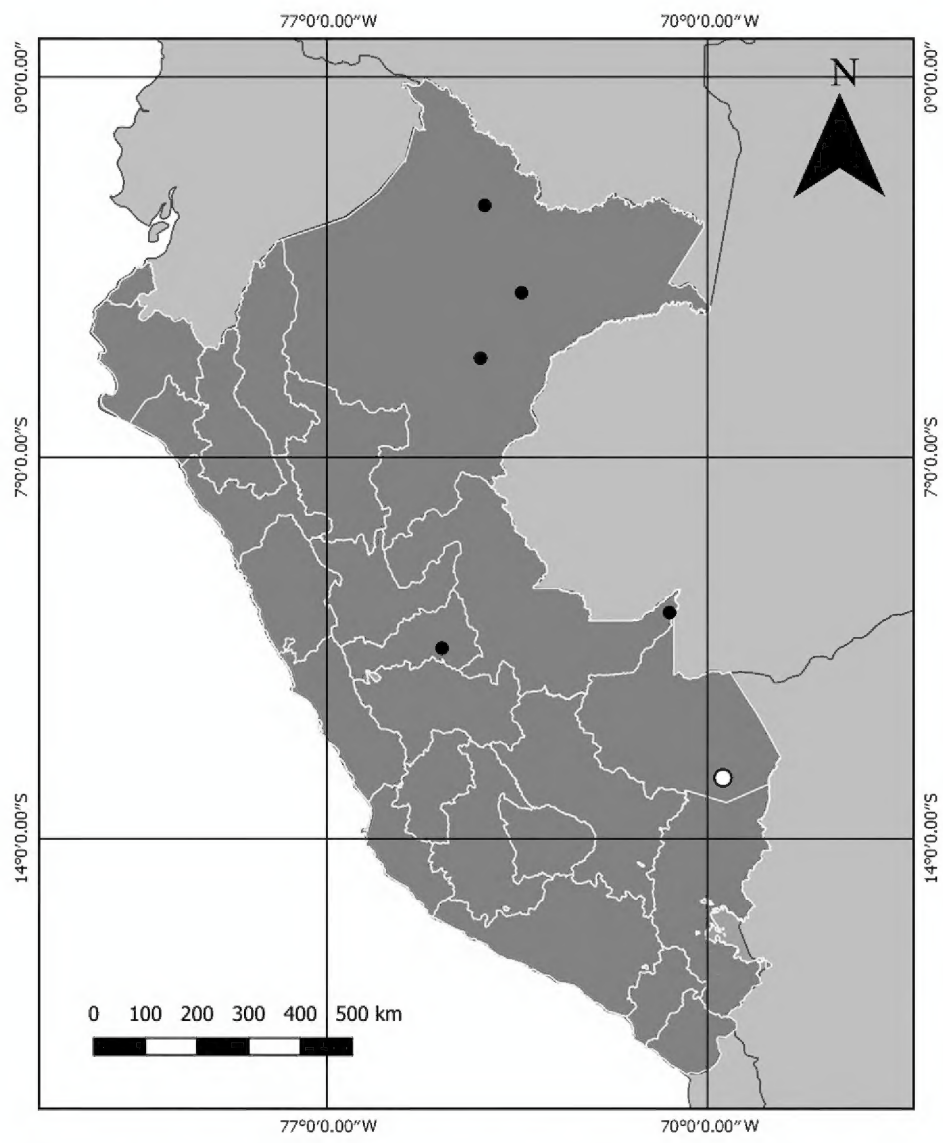

Figure 7. Distribution of *Molossops temminckii* in Peru, white circle shows this study report, black circle show previous reports.

Identification. *Molossus alvarezi* is a medium-sized bat for the genus. Cranially it is similar to *M. sinaloae* but significantly smaller in most measurements, especially in greatest length of skull (*M. alvarezi* <20.1 in females and <21.0 in males; *M. sinaloae* >21.1 in females and >22.0 in males). The greatest length of skull for our two female specimens is less than 21.0 mm (Table 2) and they

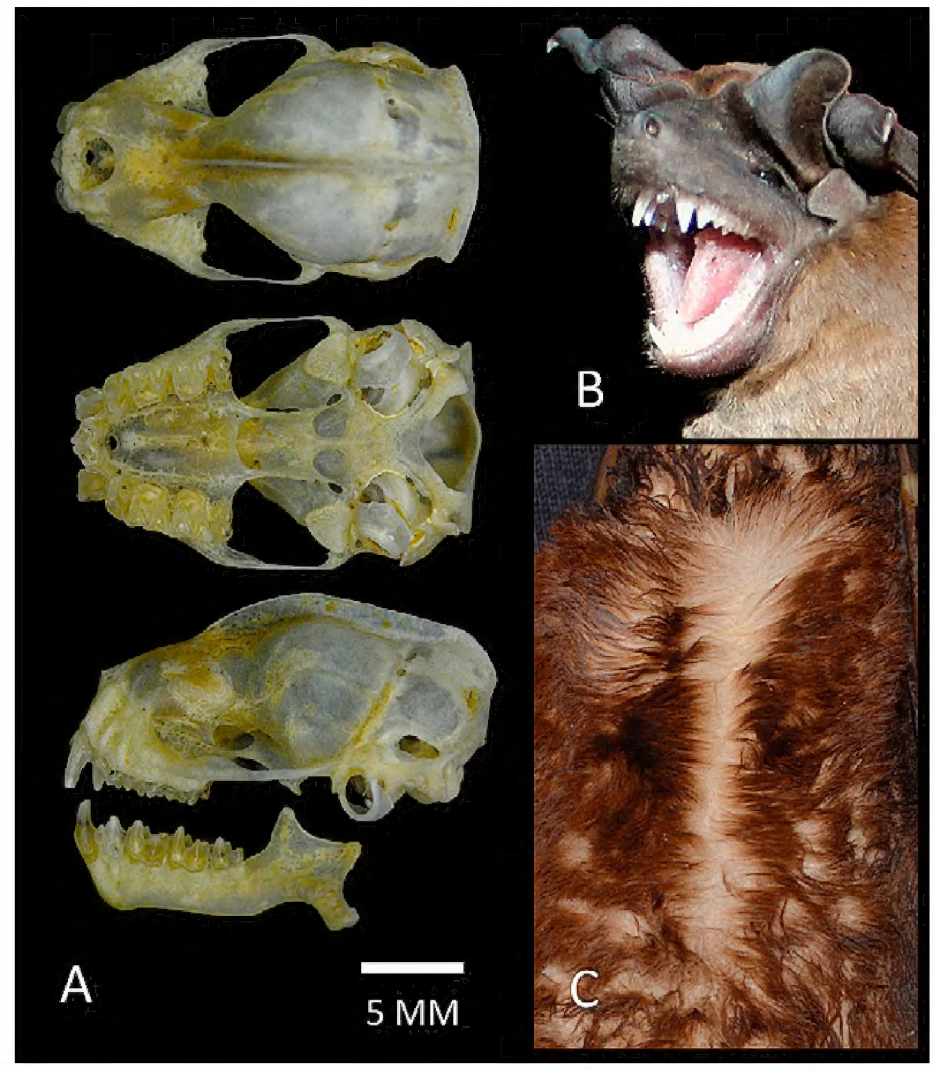

Figure 8. *Molossus alvarezi* at the limits of Alegría town, Tambopata, Madre de Dios, Peru. **A.** Skull of specimen CEBIOMAS 0513. **B.** Headshot of live specimen CEBIOMAS 0515. **C.** Color pattern of dorsal fur, CEBIOMAS 0513.

exhibit the cranial characteristics of *Molossus alvarezi* with a lower and weaker sagittal crest, especially evident in the occipital region. The lambdoid crest also is smaller and less developed; the width across its lateral borders is narrower than the breadth of the braincase. The forearm length for the species ranges from 42.7 to 47.4 mm. For our specimens the forearm varies from 49 to 49.3 mm (Table 2), larger than described by González et al. (2011) and similar to *M. rufus*. However, our specimens differ from *M. rufus* because of the bicolored dorsal fur with a pale basal band and dark brown tips present in *M. alvarezi* (Fig. 8). The dorsal fur is silky and 3.0–3.5 mm long. The dorsal hair is bicolored, white basally for more than half of the hair (González et al. 2011).

Remarks. The capture events occurred around 18:30 h and 20:00 h. Other species captured in the same location (Fig. 9) are *Artibeus glaucus*, *Artibeus lituratus*, *Artibeus obscurus*, *Artibeus planirostris*, *Carollia brevicauda*, *Carollia perspicillata*, *Chiroderma trinitatum*, *Chiroderma villosum*, *Glossophaga soricina*, *Lophostoma silvicolum*, *Mesophylla macconnelli*, *Phyllostomus elongatus*, *Platyrrhinus incarum*, *Sturnira giannae*, *Sturnira tildae*, *Trinycteris nicefori*, *Uroderma bilobatum*, *Uroderma magnirostrum*, *Eptesicus brasiliensis*, *Myotis riparius*, *Eumops maurus*, and *Thyroptera wynneae*.

Molossus coibensis Allen, 1904

New records. PERU • 1 ♂; Department of Madre de Dios, Province of Tambopata, District of Inambari; 12°53′01″S, 069°42′46″W; ~250 m a.s.l.; 2 Nov. 2016; F. Carrasco-Rueda leg.; mist net; pasture area adjacent a

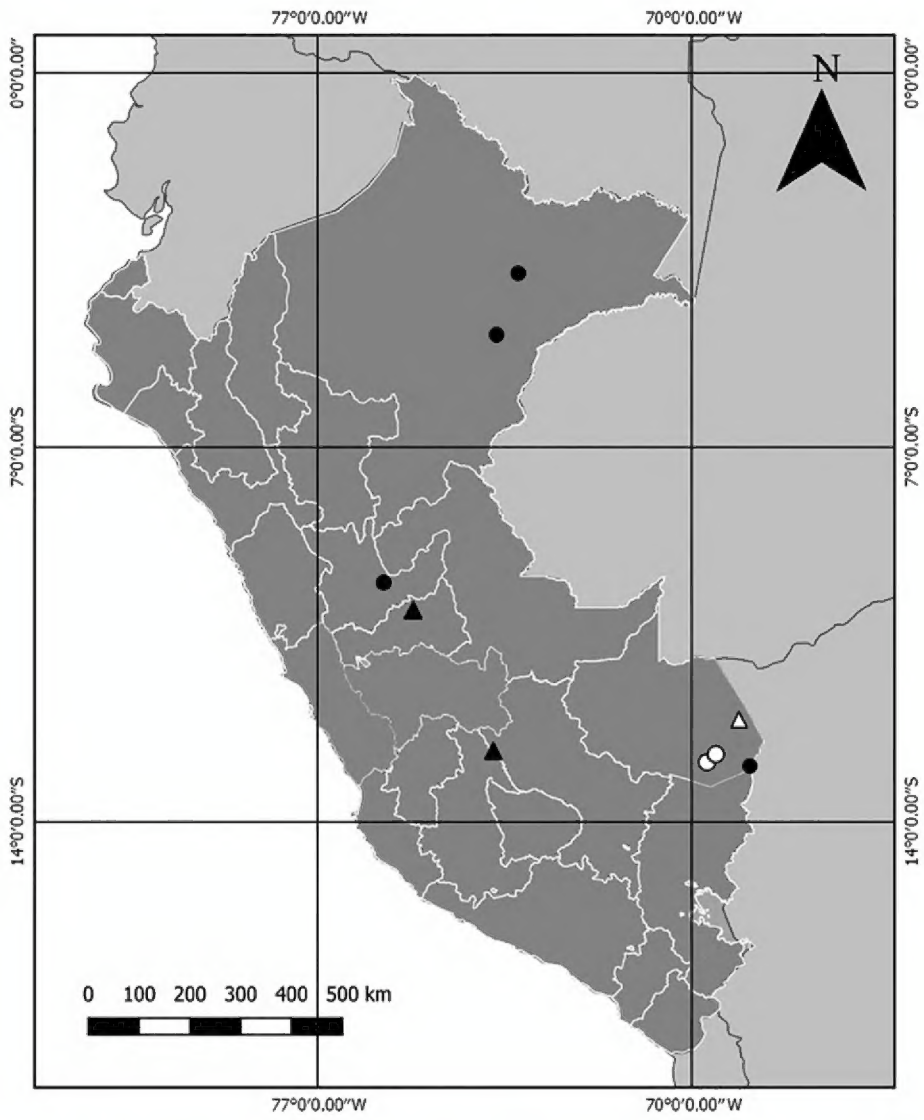

Figure 9. Distribution of two *Molossus* species in Peru: △ = new record of *M. alvarezi*; ▲ = previous reports of *M. alvarezi*; ○ = new records of *M. coibensis*; ● = previous reports of *M. coibensis*.

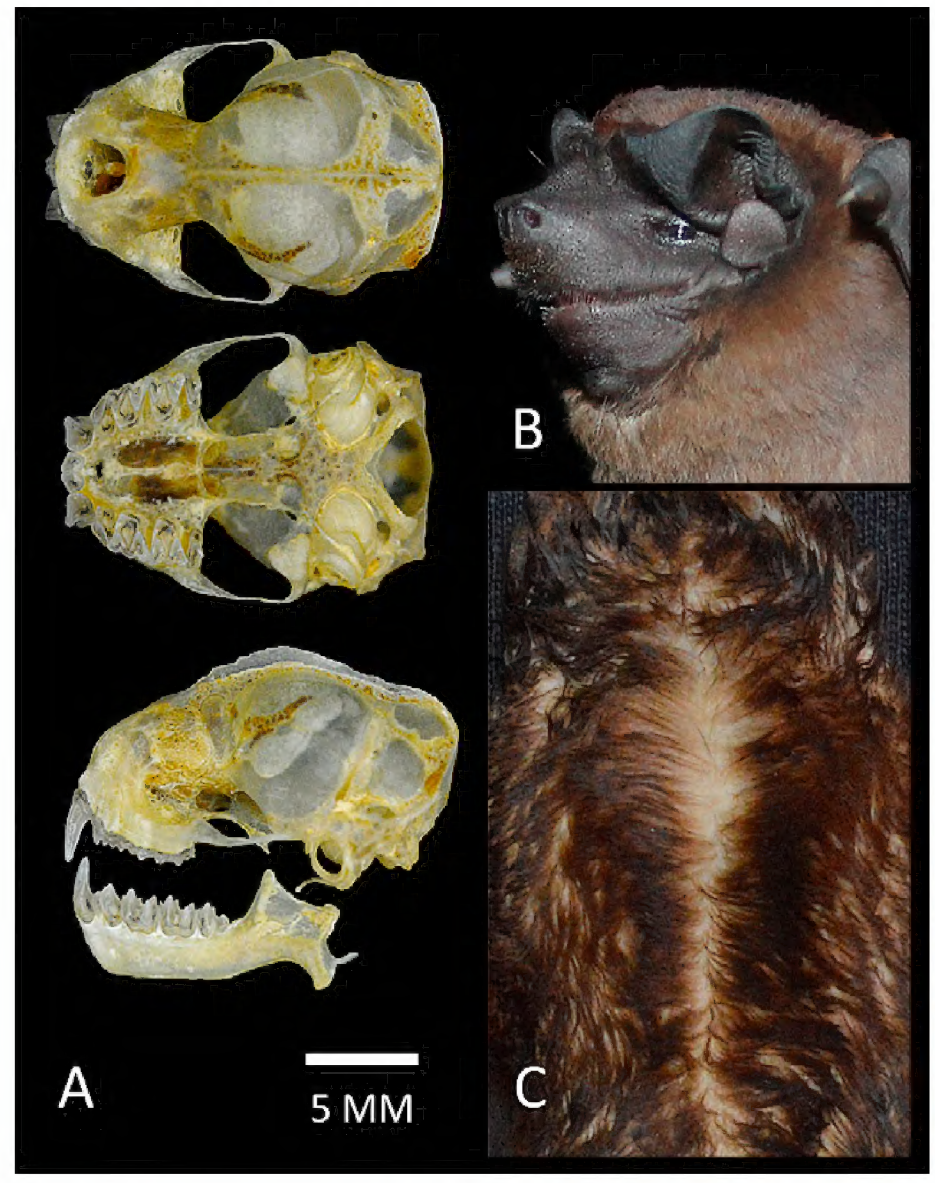

Figure 10. *Molossus coibensis* CEBIOMAS 0519 at km 70 Interoceanic Highway, Tambopata, Madre de Dios, Peru. **A.** Skull of specimen. **B.** Headshot of live specimen **C.** Color pattern of dorsal fur.

well-maintained forests inside a private property; 540 m from the Interoceanic Highway; at a cattle pasture area 200 m away from the forest edge; CEBIOMAS 0519 • 1 ♂; Department of Madre de Dios, Province of Tambopata, District of Laberinto; 12°44′23″S, 069°32′44″W; ~250 m a.s.l.; 6 Nov. 2016; F. Carrasco-Rueda leg.; mist net; forest edge area adjacent a well-maintained forest, private property; 1240 m from the Interoceanic Highway; CEBIOMAS 0521.

Identification. *Molossus coibensis* is the smallest species of the genus and usually with dark dorsal hairs varying from cocoa-brown to blackish. Dorsal hair can be monochromatic or bicolored, with a pale brown or grayish short basal band not exceeding one-third of the length of the hairs. Dorsal hairs range from 2.0 to 4.0 mm long. Our two male specimens fit the characteristics for the species, with length of dorsal fur from 3.14 to 3.13 mm. One of the specimens presents cocoa-brown dorsal fur and the other one is blackish with a pale-brown, short basal band not exceeding one-third of the length of the hairs. Forearm length averages 36.9 mm (36.1–37.9 mm) in males and 37.0 mm (34.3–37.5 mm) in females. The skull length for the species averages 16.4 mm (15.7–16.9 mm) in males and 15.5 mm (14.9–16.7 mm) in females. The forearm length of our specimens ranges from 35.7 to 36 mm, and the greatest length of skull is less than 16.1 mm for both cases (Table 2, Fig. 10). The two specimens have the typical cranial characters of the *M. coibensis* including an infraorbital foramen opening frontally, very shallow basioccipital pits, nasal process of the premaxilla not protruding over the nasal cavity, mastoid process oriented ventrally in dorsal view, quadrangular occipital complex and upper incisors with convergent tips (Correa da Costa et al. 2013; Pimenta et al. 2014; Catzeflis et al. 2016; Díaz et al. 2016; Loureiro et al. 2018b).

Remarks. The capture events occurred around 18:30 h and 19:30 h. Other species captured in the same location (Fig. 9) are *Artibeus glaucus*, *Artibeus lituratus*, *Artibeus obscurus*, *Artibeus planirostris*, *Carollia benkeithi*, *Carollia brevicauda*, *Carollia perspicillata*, *Desmodus rotundus*, *Glossophaga soricina*, *Lophostoma brasiliense*, *Lophostoma silvicolum*, *Mesophylla macconnelli*, *Phyllostomus elongatus*, *Phyllostomus hastatus*, *Platyrrhinus brachycephalus*, *Platyrrhinus incarum*, *Rhinophylla pumilio*, *Sphaeronycteris toxophyllum*, *Sturnira giannae*, *Sturnira tildae*, *Tonatia maresi*, *Trachops cirrhosus*, *Uroderma bilobatum*, *Uroderma magnirostrum*, *Vampyressa thyone*, *Vampyriscus bidens*, *Eptesicus brasiliensis*, *Eptesicus furinalis*, *Myotis riparius*, *Myotis simus*, *Noctilio albiventris*, *Molossops temminckii*, and *Molossus* sp.

Discussion

The Department of Madre de Dios in the Peruvian Amazon is a highly diverse area that is considered the Capital of Biodiversity by the Peruvian Government. The protected areas in this department, such as Manu National Park, Tambopata National Reserve, Amarakaeri Comunal Reserve, and Bahuaja Sonene National Park, are important in preserving the region's great biodiversity. However, species that may be considered rare and deserve

more attention are also found outside protected areas.

With this work, we extend the geographic distribution of three species: *Thyroptera wynneae*, *Molossops temminckii*, and *Molossus alvarezi*. The specimen for *Thyroptera wynneae*, reported here, represents the first female of the species from Peru and the southernmost record in the country. The holotype and closest documented record are from the Centro de Investigación Jenaro Herrera, Department of Loreto (Velazco et al. 2014); our new record extends the geographic distribution of the species in Peru by approximately 930 km. More specimens are needed to determine if the differences in size between females and males for this species are due to sexual dimorphism. Our record of *M. temminckii* is 355 km south from the previous southernmost record of the species in Peru at Rio la Novia, Ucayali (Ruelas et al. 2018). Furthermore, our record of *M. alvarezi* represents the easternmost report for this species in Peru, 500 km to the east from where Eger (2008) reported this species at Ayacucho. Our study presents the first records of these three species from the Department of Madre de Dios.

Eumops maurus and *Molossus coibensis* are not frequently reported, and few records for *E. maurus* are available in Peru. Our study found this species 98 km north from the closest previously known occurrence at Pampas del Heath, Madre de Dios. *Eumops maurus* has been recorded in the Amazon lowlands, Atlantic forest, savannahs, gallery forest, swampy evergreen forest, swamps dominated by palms, flooded pastures, tierra-firme forest, urban areas, and 15-year-old pine plantations (Sánchez H. et al. 1992; Reid et al. 2000; Best et al. 2001; Luna et al. 2002; Sodré et al. 2008; Diaz 2011; López-Baucells et al. 2018). The bat species presumably roosts in the leaves of palms, such as *Syagrus oleracea* and *Mauritia flexuosa* (Sodré et al. 2008). We captured this species in a cattle pasture.

Our report for *M. coibensis* is 72 km northwest from the closest previously known locality in Pampas del Heath (Medina et al. 2016). Because *M. coibensis* can be confused with *M. molossus* detailed examination is recommended (Diaz 2011; Gregorin et al. 2011; Pimenta et al. 2014). Correa da Costa et al. (2013) reported *M. coibensis* in the roofs of houses covered with cement-fiber tiles in a town. This species shows a resilience to inhabiting areas with the presence of human activities.

Molossops temminckii feeds on insects, especially coleopterans (Ibáñez and Ochoa 1985; Anderson 1997; Emmons and Feer 1997). This bat species can be found under tree bark, in cracks and holes, and in buildings; it rests in small groups of two or three individuals in tree holes up to 3 m from the ground (Ibáñez and Ochoa 1985; Anderson 1997). This species starts activity at dusk (Vizotto and Taddei 1976). We captured this species at 18:00 h in a cattle pasture.

Loureiro et al. (2019) demonstrated that *M. alvarezi* from the Yucatan Peninsula is genetically distinct from *M. sinaloae* from western Mexico and that these species are not sister taxa. In addition, Loureiro et al. (2019) mentioned that individuals previously misidentified as *M. sinaloae* in Honduras are more related to *M. alvarezi* than to *M. sinaloae*, which would indicate that *M. alvarezi* has a broader distribution that extends from the Yucatan Peninsula to Central and South America. This species is said to occur in Peru by Velazco (2020). *Molossus alvarezi* feeds on insects, mainly Lepidoptera (Bowles et. al 1990). *Molossops alvarezi* has been found inside cracks in a stonewall, between rafters and the corrugated metal roof of a building, and in caves (Jones et al. 1971; Marinkelle and Cadena 1972). In Yucatán, *M. alvarezi* has a 2-hour activity peak after sunset, with a slightly lower activity peak before sunrise (Bowles et al. 1990). Both specimens that we captured were at the forest edge alongside the cattle pasture, and captures occurred at 18:30 h and 20:00 h.

Herein, we help fill information gaps for five rarely captured species of bats, including three of them (*T. wynneae*, *E. maurus*, *M. alvarezi*) which are Data Deficient. We also contribute information on the habitats where these species were captured, including cattle pastures 225 and 1240 m from the Interoceanic Highway. We highlight here the importance of conducting studies in impacted areas in addition to protected and well-maintained forests.

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Authors' Contributions

FCR received funding for research, defined sampling design, conducted the survey, collected specimens and made specimen identification in the field. FCR and DJZ photographed living specimens. YA, DJZ and LCE helped collect specimens. HTZ and YA photographed

skulls and fur. YA, FCR, and LCE formatted the references. DJZ created maps. LCE edited the photographs and produced the figures. HTZ prepared the specimens and identified the species. FCR and HTZ wrote the manuscript. All authors contributed to the literature review and read and approved the final manuscript.

References

Allen JA (1904) New bats from tropical America, with note on species of *Otopterus*. Bulletin of the American Museum Natural History 20: 227–237.

Anderson S (1997) Mammals of Bolivia, taxonomy and distribution. Bulletin of the American Museum of Natural History 231: 1–652.

Best TL, Hunt JL, McWilliams LA, Smith KG (2001) *Eumops maurus*. Mammalian Species (667): 1–3. https://doi.org/10.2307/0.667.1

Bowles JB, Heideman PD, Erickson KR (1990) Observations on six species of free-tailed bats (Molossidae) from Yucatan, Mexico. The Southwestern Naturalist 35(2): 151–157. https://doi.org/10.2307/3671536

Burmeister H (1854) Systematische uebersicht der thiere brasiliens, welche während einer reise durch die provinzen von Río de Janeiro und Minas Geräes gesammelt oder beobachtet wurden. Säugethiere (Mammalia), Berlin. 372 pp.

Burnett SE, Jennings JB, Rainey JC, Best TL (2001) *Molossus bondae*. Mammalian Species 668: 1–3. https://doi.org/10.2307/0.668.1

Cabrera A (1930) Breve sinopsis de los murciélagos argentinos. Revista del Centro de Estudiantes de Agronomía y Veterinaria Universidad de Buenos Aires 23: 418–442.

Carrasco-Rueda F (2018) Land-use change and bat biodiversity: understanding patterns, drivers, and impacts of mitigation efforts. PhD dissertation, University of Florida, Gainesville, USA, 205 pp.

Carrasco-Rueda F, Loiselle BA (2020) Dimensions of phyllostomid bat diversity and assemblage composition in a tropical forest-agricultural landscape. Diversity 12 (6): 238. https://doi.org/10.3390/d12060238

Carrasco-Rueda F, Zavala DJ, Alcarraz Y, Carrasco-Escudero L, Zamora HT (2021) mddbats. Check List. Occurrence dataset. https://doi.org/10.15468/k57hmb. Accessed on: 2021-01-26.

Castilla M, Martínez J, Díaz M (2016) Mammalia, Chiroptera, Molossidae, *Molossops temminckii* (Burmeister, 1854), and Vespertilionidae, *Eptesicus furinalis* (d'Orbigny and Gervais, 1847): new locality record and distribution extension in Córdoba Province, Argentina. Check List 6 (4): 549–551. https://doi.org/10.15560/6.4.549

Catzeflis FM, Gager Y, Ruedi M, de Thoisy B (2016) The French Guianan endemic *Molossus barnesi* (Chiroptera: Molossidae) is a junior synonym for *M. coibensis*. Mammalian Biology 81: 431–438. https://doi.org/10.1016/j.mambio.2016.05.004

Correa da Costa LJ, Goncalves de Andrade FA, Uieda W, Gregorin R, Barroncas Fernandes ME (2013) First record of *Molossus coibensis* (Chiroptera: Molossidae) in the Brazilian Amazon. Mastozoología Neotropical 20: 143–147.

Díaz M (2011) New records of bats from the northern region of the Peruvian Amazon. Zoological Research 32(2): 168–78.

Díaz MM, Solari S, Aguirre LF, Aguiar LMS, Barquez RM (2016) Clave de identificación de los murciélagos de Sudamérica. Chave de identificação dos morcegos da América do Sul. Publicación Especial N° 2, PCMA (Programa de Conservación de los Murciélagos de Argentina), Tucumán, Argentina. 160 pp.

Dolan PG (1989) Systematics of Middle American mastiff bats of the genus *Molossus*. Special Publication, The Museum Texas Tech University 29: 1–71.

Eger J (2008) Family Molossidae. In: Gardner AL (Ed.) Mammals of South America. University of Chicago Press, Chicago, USA, 399–440.

Emmons L, Feer F (1997) Neotropical rainforest mammals: a field guide. 2nd edition. University of Chicago Press, Chicago, USA, 396 pp.

Fabián ME, Gregorin R (2007) Familia Molossidae. In: Reis NR, Peracchi AL, Pedro WA, Lima IP (Eds.) Morcegos do Brasil. Privately published, Londrina, Brazil, 149–195.

Freeman PW (1981) A multivariate study of the family Molossidae (Mammalia: Chiroptera): morphology, ecology, evolution. Fieldiana Zoology, New Series 1316: 1–173. https://doi.org/10.5962/bhl.title.3128

Gamboa S, Díaz M (2019) *Molossops temminckii* (Chiroptera: Molossidae). Mammalian Species 51 (976): 34–45. https://doi.org/10.1093/mspecies/sez006

González-Ruiz N, Ramírez-Pulido J, Arroyo-Cabrales J (2011) A new species of mastiff bat (Chiroptera: Molossidae: *Molossus*) from Mexico. Mammalian Biology 76: 461–469. https://doi.org/10.1016/j.mambio.2010.06.004

Guillén-Servent A, Ibañez C (2007) Unusual echolocation behavior in a small molossid bat, *Molossops temminckii*, that forages near background clutter. Behavioral Ecology and Sociobiology 61: 1599–1613. https://doi.org/10.1007/s00265-007-0392-4

Gregorin R (2009) Phylogeny of *Eumops* (Chiroptera: Molossidae) using morphological data. Acta Chiropterologica 11 (2): 247–258. https://doi.org/10.3161/150811009X485495

Gregorin R, Tahara AS, Buzzato DF (2011) *Molossus aztecus* and other small *Molossus* (Chiroptera: Molossidae) in Brazil. Acta Chiropterologica 13: 311–317. https://doi.org/10.3161/150811011X624794

Hice CL, Velazco PM, Willig MR (2004) Bats of the Reserva Allpahuayo-Mishana, northeastern Peru, with notes on community structure. Acta Chiropterologica 6 (2): 319–334. https://doi.org/10.3161/001.006.0210

Hoppe JP, Pimenta VT, Ditchfield AD (2014) First occurrence of the recently described Patricia's Disk-winged bat *Thyroptera wynneae* (Chiroptera: Thyropteridae) in Espirito Santo, southeastern Brazil. Check List 10 (3): 645–647. https://doi.org/10.15560/10.3.645

Husson AM (1962) The bats of Suriname. Zoologische Verhandelingen 58 (1): 1–278.

Ibañez C, Ochoa GC (1985) Distribución y taxonomía de *Molossops temminckii* (Chiroptera: Molossidae) en Venezuela. Doñana, Acta Vertebrata 12 (1): 141–150.

Jones JK, Smith JD, Turner RW (1971) Noteworthy records of bats from Nicaragua, with a checklist of the chiropteran fauna of the country. Occasional papers of the Museum of Natural History, The University of Kansas 17 (2): 1–35.

Koopman KF (1978) Zoogeography of Peruvian bats, with special emphasis on the role of the Andes. American Museum Novitates 2651: 1–33.

López-Baucells A, Rocha R, Tavares V, Moras L, Silva SE, Bobrowiec PED, Meyer CF (2018) Molecular, morphological and acoustic identification of *Eumops maurus* and *Eumops hansae* (Chiroptera: Molossidae) with new reports from Central Amazonia. Tropical Zoology 31 (1): 1–20. https://doi.org/10.1080/03946975.2017.1382284

Loureiro LO, Lim BK and Engstrom MD (2018a) A new species of mastiff bat (Chiroptera, Molossidae, *Molossus*) from Guyana and Ecuador. Mammalian Biology 90: 10–21. https://doi.org/10.1016/j.mambio.2018.01.008

Loureiro LO, Gregorin R, Perini FA (2018b) Diversity, morphological phylogeny, and distribution of bats of the genus *Molossus* É. Geoffroy, 1805 (Chiroptera: Molossidae) in Brazil. Zoosystema 40 (18): 425–452. https://doi.org/10.5252/zoosystema2018v40a18

Loureiro LO, Engstrom MD, Lim BK (2019) Not all *Molossus* are created equal: genetic variation in the mastiff bat reveals diversity masked by conservative morphology. Acta Chiropterologica 21 (1): 51–64. https://doi.org/10.3161/15081109ACC2019.21.1.004

Loureiro LO, Engstrom MD, Lim BK (2020) Single nucleotide polymorphisms (SNPs) provide unprecedented resolution of species boundaries, phylogenetic relationships, and genetic diversity in

the mastiff bats (*Molossus*). Molecular Phylogenetics and Evolution 143: 106690. https://doi.org/10.1016/j.ympev.2019.106690

Luna L, Emmons L, Romo M, Cornejo A (2002) Mamíferos encontrados en el Santuario Nacional Pampas del Heath durante la expedición del RAP de 1996. In: Montambault JR (Ed.) Informes de las evaluaciones biológicas Pampas del Heath Perú, Alto Madidi Bolivia y Pando Bolivia. RAP Bulletin of Biological Assessment 24: 66–70.

Marín-Vasquez A, Aguilar-González A (2005) Murciélagos (Chiroptera) del departamento de Caquetá - Colombia. Biota Colombiana 6 (2): 211–218.

Marinkelle CJ, Cadena A (1972) Notes on bats new to the fauna of Colombia. Mammalia 36 (1): 50–58. https://doi.org/10.1515/mamm.1972.36.1.50

Medina CE, Pino KS, Pari A, Llerena G, Zeballos H, López E (2016) Mammalian diversity in the Savanna from Peru, with three new addictions from country. Papéis Avulsos de Zoologia 56 (2): 9–26. https://doi.org/10.1590/0031-1049.2016.56.02

Miller GS (1913) Notes on the bats of the genus *Molossus*. Proceeding of the United States National Museum 46: 85–92.

Miller GS Jr. (1906) Twelve new genera of bats. Proceedings of Biological Society of Washington 19: 83–87.

Oldfield T (1901) On a collection of mammals from the Kanuku Mountains, British Guiana. Annals and Magazine of Natural History (Series 7) 8 (44): 139–154. https://doi.org/10.1080/03745480109442900

Pacheco V, Cadenillas R, Salas E, Tello C, Zeballos H (2009) Diversidad y endemismo de los mamíferos del Perú. Revista Peruana de Biología 16(1): 5–32. https://doi.org/10.15381/rpb.v16i1.111

Pérez C (2017) Estudio morfológico y morfométrico del género *Molossus* (Chiroptera: Molossidae) en Perú. Master's thesis, Universidad Nacional de San Agustín, Arequipa, 84 pp.

Pimenta VT, Fonseca BS, Hoppe JPM, Ditchfield AD (2014) First occurrence of *Molossus coibensis* Allen, 1904 (Chiroptera: Molossidae) in Atlantic Forest. Chiroptera Neotropical 20: 1237–1242.

Reid FA, Engstrom MD, Lim BK (2000) Noteworthy records of bats from Ecuador. Acta Chiropterologica 2 (1): 37–51.

Ruelas D, Pacheco V, Espinoza N, Loaiza C (2018) Bat diversity from the Rio La Novia Conservation Concession, Ucayali, Peru. Revista Peruana de Biología 25 (3): 211–220. https://doi.org/10.15381/rpb.v25i3.14091

Saldana-Vazquez RA, Munguia-Rosas MA (2013) Lunar phobia in bats and its ecological correlates: a meta-analysis. Mammalian Biology 78 (3): 216–219. https://doi.org/10.1016/j.mambio.2012.08.004

Sánchez-H J, Ochoa J, Ospino A (1992) First record of *Eumops maurus* (Chiroptera: Molossidae) for Venezuela. Mammalia 56 (1): 151–152.

Sikes RS, The Animal Care and Use Committee of the American Society of Mammalogists (2016) 2016 Guidelines of the American Society of Mammalogists for the use of wild mammals in research and education. Journal of Mammalogy 97 (3): 663–668. https://doi.org/10.1093/jmammal/gyw078

Sodré MM, Rosa ARD, Gregorin R, Guimarães MM (2008) Range extension for Thomas' Mastiff bat *Eumops maurus* (Chiroptera: Molossidae) in northern, central and southeastern Brazil. Revista Brasileira de Zoologia 25 (2): 379–382. https://doi.org/10.1590/S0101-81752008000200027

Tirira DG (2017) Mamíferos del Ecuador. Editorial Murciélago Blanco / Fundación Mamíferos y Conservación, Quito, Ecuador, 600 pp.

Tuttle MD (1970) Distribution and zoogeography of Peruvian bats, with comments on natural history. University of Kansas Science Bulletin 49: 45–86. https://doi.org/10.5962/bhl.part.9197

Velazco PM (2020) Murciélagos del Peru / Bats of Peru. http://www.paulvelazco.com/murcielagos_peru.html. Accessed on: 2020-11-29.

Velazco PM, Gregorin R, Voss RS, Simmons NB (2014) Extraordinary local diversity of Disk-winged Bat (Thyropteridae: *Thyroptera*) in northeastern Peru with the description of a new species and comments on roosting behavior. American Museum Novitates 3795: 1–28. https://doi.org/10.1206/3795.1

Vizotto LD, Taddei VA (1976) Notas sobre *Molossops temminckii temminckii* y *M. planirostris* (Chiroptera: Molossidae). Naturalia 2: 47–59.

Wilson DE, Mittermeier RA (2019) Handbook of the mammals of the world. Volume 9: Bats. Lynx Edicions, Barcelona, Spain, 1008 pp.